Report from the Airplane Performance Harmonization Working Group

Issue: En Route Limitations

Rule Sections: FAR 121.191, 121.193, 135.381, 135.383/JAR-OPS 1.500, 1.505

1 - What is underlying safety issue to be addressed by the FAR/JAR? [Explain the underlying safety rationale for the requirement. Why should the requirement exist? What prompted this rulemaking activity (e.g., new technology, service history, etc.)?]

The en route performance operating limitations ensure that airplanes operated under parts 121 and 135 or JAR-OPS 1 take off at weights that will allow safe clearance of all en route terrain, even if an engine fails at the most critical point en route. For airplanes with three or more engines operating on routes with a point more than 90 minutes away from an alternate airport, there is a further limitation to ensure that the takeoff weight would allow safe clearance of all en route terrain if two engines fail at the most critical point en route.

2 - What are the current FAR and JAR standards relative to this subject? [Reproduce the FAR and JAR rules text as indicated below.]

Current FAR text:

Part 121

FAR 121.191 Transport category airplanes: Turbine engine powered: En route limitations: One engine inoperative.

(a) No person operating a turbine engine powered transport category airplane may take off that airplane at a weight, allowing for normal consumption of fuel and oil, that is greater than that which (under the approved, one engine inoperative, en route net flight path data in the Airplane Flight Manual for that airplane) will allow compliance with paragraph (a) (1) or (2) of this section, based on the ambient temperatures expected en route:

(1) There is a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five statute miles on each side of the intended track, and, in addition, if that airplane was certificated after August 29, 1959 (SR 422B) there is a positive slope at 1,500 feet above the airport where the airplane is assumed to land after an engine fails.

(2) The net flight path allows the airplane to continue flight from the cruising altitude to an airport where a landing can be made under § 121.197, clearing all terrain and obstructions within five statute miles of the intended track by at least 2,000 feet vertically and with a positive slope at 1,000 feet above the airport where the airplane lands after an engine fails, or, if that airplane was certificated after September 30, 1958 (SR 422A,

422B), with a positive slope at 1,500 feet above the airport where the airplane lands after an engine fails.

(b) For the purposes of paragraph (a)(2) of this section, it is assumed that—

(1) The engine fails at the most critical point en route;

(2) The airplane passes over the critical obstruction, after engine failure at a point that is no closer to the obstruction than the nearest approved radio navigation fix, unless the Administrator authorizes a different procedure based on adequate operational safeguards;

(3) An approved method is used to allow for adverse winds:

(4) Fuel jettisoning will be allowed if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to insure a safe procedure;

(5) The alternate airport is specified in the dispatch or flight release and meets the prescribed weather minimums; and

(6) The consumption of fuel and oil after engine failure is the same as the consumption that is allowed for in the approved net flight path data in the Airplane Flight Manual.

Sec. 121.193 Transport category airplanes: Turbine engine powered: En route limitations: Two engines inoperative.

(a) Airplanes certificated after August 26, 1957, but before October 1, 1958 (SR 422). No person may operate a turbine engine powered transport category airplane along an intended route unless he complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets the requirements of § 121.197.

(2) Its weight, according to the two-engine-inoperative, en route, net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets the requirements of § 121.197, with a net flight path (considering the ambient temperature anticipated along the track) having a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five miles on each side of the intended track, or at an altitude of 5,000 feet, whichever is higher.

For the purposes of paragraph (a)(2) of this section, it is assumed that the two engines fail at the most critical point en route, that if fuel jettisoning is provided, the airplane's weight

at the point where the engines fail includes enough fuel to continue to the airport and to arrive at an altitude of at least 1,000 feet directly over the airport, and that the fuel and oil consumption after engine failure is the same as the consumption allowed for in the net flight path data in the Airplane Flight Manual.

(b) Aircraft certificated after September 30, 1958, but before August 30, 1959 (SR 422A). No person may operate a turbine engine powered transport category airplane along an intended route unless he complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets the requirements of § 121.197.

(2) Its weight, according to the two-engine-inoperative, en route, net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets the requirements of § 121.197, with a net flight path (considering the ambient temperatures anticipated along the track) having a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within 5 miles on each side of the intended track, or at an altitude of 2,000 feet, whichever is higher.

For the purposes of paragraph (b)(2) of this section, it is assumed that the two engines fail at the most critical point en route, that the airplane's weight at the point where the engines fail includes enough fuel to continue to the airport, to arrive at an altitude of at least 1,500 feet directly over the airport, and thereafter to fly for 15 minutes at cruise power or thrust, or both, and that the consumption of fuel and oil after engine failure is the same as the consumption allowed for in the net flight path data in the Airplane Flight Manual.

(c) Aircraft certificated after August 29, 1959 (SR 422B). No person may operate a turbine engine powered transport category airplane along an intended route unless he complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets the requirements of § 121.197.

(2) Its weight, according to the two-engine inoperative, en route, net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets the requirements of § 121.197, with the net flight path (considering the ambient temperatures anticipated along the track) clearing vertically by at least 2,000 feet all terrain and obstructions within five statute miles (4.34 nautical miles) on each side of the intended track. For the purposes of this subparagraph, it is assumed that—

(i) The two engines fail at the most critical point en route;

(ii) The net flight path has a positive slope at 1,500 feet above the airport where the landing is assumed to be made after the engines fail;

(iii) Fuel jettisoning will be approved if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(iv) The airplane's weight at the point where the two engines are assumed to fail provides enough fuel to continue to the airport, to arrive at an altitude of at least 1,500 feet directly over the airport, and thereafter to fly for 15 minutes at cruise power or thrust, or both; and

(v) The consumption of fuel and oil after the engine failure is the same as the consumption that is allowed for in the net flight path data in the Airplane Flight Manual.

Part 135

FAR 135.381 Large transport category airplanes: Turbine engine powered: En route limitations: One engine inoperative.

(a) No person operating a turbine engine powered large transport category airplane may take off that airplane at a weight, allowing for normal consumption of fuel and oil, that is greater than that which (under the approved, one engine inoperative, en route net flight path data in the Airplane Flight Manual for that airplane) will allow compliance with paragraph (a) (1) or (2) of this section, based on the ambient temperatures expected en route.

(1) There is a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five statute miles on each side of the intended track, and, in addition, if that airplane was certificated after August 29, 1958 (SR422B), there is a positive slope at 1,500 feet above the airport where the airplane is assumed to land after an engine fails.

(2) The net flight path allows the airplane to continue flight from the cruising altitude to an airport where a landing can be made under § 135.387 clearing all terrain and obstructions within five statute miles of the intended track by at least 2,000 feet vertically and with a positive slope at 1,000 feet above the airport where the airplane lands after an engine fails, or, if that airplane was certificated after September 30, 1958 (SR422A, 422B), with a positive slope at 1,500 feet above the airport where the airplane lands after an engine fails.

(b) For the purpose of paragraph (a)(2) of this section, it is assumed that—

(1) The engine fails at the most critical point en route;

(2) The airplane passes over the critical obstruction, after engine failure at a point that is no closer to the obstruction than the approved radio navigation fix, unless the Administrator authorizes a different procedure based on adequate operational safeguards;

(3) An approved method is used to allow for adverse winds;

(4) Fuel jettisoning will be allowed if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(5) The alternate airport is selected and meets the prescribed weather minimums; and

(6) The consumption of fuel and oil after engine failure is the same as the consumption that is allowed for in the approved net flight path data in the Airplane Flight Manual.

§ 135.383 Large transport category airplanes: Turbine engine powered: En route limitations: Two engines inoperative.

(a) Airplanes certificated after August 26, 1957, but before October 1, 1958 (SR422). No person may operate a turbine engine powered large transport category airplane along an intended route unless that person complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets § 135.387.

(2) Its weight, according to the two-engine-inoperative, en route, net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets § 135.387, with a net flight path (considering the ambient temperature anticipated along the track) having a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five statute miles on each side of the intended track, or at an altitude of 5,000 feet, whichever is higher.

For the purposes of paragraph (a)(2) of this section, it is assumed that the two engines fail at the most critical point en route, that if fuel jettisoning is provided, the airplane's weight at the point where the engines fail includes enough fuel to continue to the airport and to arrive at an altitude of at least 1,000 feet directly over the airport, and that the fuel and oil consumption after engine failure is the same as the consumption allowed for in the net flight path data in the Airplane Flight Manual.

(b) Airplanes certificated after September 30, 1958, but before August 30, 1959 (SR422A). No person may operate a turbine engine powered large transport category airplane along an intended route unless that person complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets § 135.387.

(2) Its weight, according to the two-engine-inoperative, en route, net flight path data in the Airplane Flight Manual allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets § 135.387 with a net flight path (considering the ambient temperatures anticipated along the track) having a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five statute miles on each side of the intended track, or at an altitude of 2,000 feet, whichever is higher.

For the purpose of paragraph (b)(2) of this section, it is assumed that the two engines fail at the most critical point en route, that the airplane's weight at the point where the engines fail includes enough fuel to continue to the airport, to arrive at an altitude of at least 1,500 feet directly over the airport, and after that to fly for 15 minutes at cruise power or thrust, or both, and that the consumption of fuel and oil after engine failure is the same as the consumption allowed for in the net flight path data in the Airplane Flight Manual.

(c) Aircraft certificated after August 29, 1959 (SR422B). No person may operate a turbine engine powered large transport category airplane along an intended route unless that person complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets § 135.387.

(2) Its weight, according to the two-engine-inoperative, en route, net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets § 135.387, with the net flight path (considering the ambient temperatures anticipated along the track) clearing vertically by at least 2,000 feet all terrain and obstructions within five statute miles on each side of the intended track. For the purposes of this paragraph, it is assumed that—

(i) The two engines fail at the most critical point en route;

(ii) The net flight path has a positive slope at 1,500 feet above the airport where the landing is assumed to be made after the engines fail;

(iii) Fuel jettisoning will be approved if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(iv) The airplane's weight at the point where the two engines are assumed to fail provides enough fuel to continue to the airport, to arrive at an altitude of at least 1,500 feet directly over the airport, and after that to fly for 15 minutes at cruise power or thrust, or both; and

(v) The consumption of fuel and oil after the engines fail is the same as the consumption that is allowed for in the net flight path data in the Airplane Flight Manual.

JAR-OPS 1.500 En-route – One Engine Inoperative (See AMC OPS 1.500)

(a) An operator shall ensure that the one engine inoperative en-route net flight path data shown in the Aeroplane Flight Manual, appropriate to the meteorological conditions expected for the flight, complies with either subparagraph (b) or (c) at all points along the route. The net flight path must have a positive gradient at 1500 ft above the aerodrome where the landing is assumed to be made after engine failure. In meteorological conditions requiring the operation of ice protection systems, the effect of their use on the net flight path must be taken into account.

(b) The gradient of the net flight path must be positive at least 1000 ft above all terrain and obstructions along the route within 9.3 km (5 nm) on either side of the intended track.

(c) The net flight path must permit the aeroplane to continue flight from the cruising altitude to an aerodrome where a landing can be made in accordance with JAR-OPS 1.510 and 1.515 or 1.520 as appropriate, the net flight path clearing vertically, by at least 2000 ft, all terrain and obstructions along the route within 9.3 km (5 nm) on either side of the intended track in accordance with subparagraphs (1) to (4) below:

(1) The engine is assumed to fail at the most critical point along the route;

(2) Account is taken of the effects of winds on the flight path;

(3) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome where the aeroplane is assumed to land after engine failure with the required reserves of JAR-OPS 1.255 appropriate to an alternate aerodrome, if a safe procedure is used, and

(4) The aerodrome where the aeroplane is assumed to land after engine failure must meet the following criteria:

(i) The performance requirements at the expected landing mass are met; and

(ii) Weather reports or forecasts, or any combination thereof, and field condition reports indicate that a safe landing can be accomplished at the estimated time of landing.

(d) When showing compliance with JAR-OPS 1.500, an operator must increase the width margins of subparagraphs (b) and (c) above to 18.5 km (10 nm) if the navigational accuracy does not meet the 95% containment level.

JAR-OPS 1.505 En-route – Aeroplanes with Three or More Engines, Two Engines Inoperative

(a) An operator shall ensure that at no point along the intended track will an aeroplane having three or more engines be more than 90 minutes at the all engines long range cruising speed, at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met unless it complies with subparagraphs (b) to (f) below.

(b) The two engines inoperative en-route net flight path data must permit the aeroplane to continue the flight, in the expected meteorological conditions, from the point where two engines are assumed to fail simultaneously, to an aerodrome at which it is possible to land and come to a complete stop when using the prescribed procedure for a landing with two engines inoperative. The net flight path must clear vertically, by at least 2000 ft all terrain and obstructions along the route within 9. 3 km (5 nm) on either side of the intended track. At altitudes and in meteorological conditions requiring ice protection systems to be operable, the effect of their use on the net flight path data must be taken into account. If the navigational accuracy does not meet the 95% containment level, an operator must increase the width margin given above to 18.5 km (10 nm).

(c) The two engines are assumed to fail at the most critical point of that portion of the route where the aeroplane is more than 90 minutes, at the all engines long range cruising speed at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met.

(d) The net flight path must have a positive gradient at 1500 ft above the aerodrome where the landing is assumed to be made after the failure of two engines.

(e) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome with the required fuel reserves, if a safe procedure is used.

(f) The expected mass of the aeroplane at the point where the two engines are assumed to fail must not be less than that which would include sufficient fuel to proceed to an aerodrome where the landing is assumed to be made, and to arrive there at least 1500 ft directly over the landing area and thereafter to fly level for 15 minutes.

2a – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed? [Reproduce text from issue papers, special conditions, policy, certification action items, etc., that have been used relative to this issue]

N/A

3 - What are the differences in the FAA and JAA standards or policy and what do these differences result in? [Explain the differences in the standards or policy, and what these

differences result in relative to (as applicable) design features/capability, safety margins, cost, stringency, etc.]

The JAR explicitly requires that in meteorological conditions requiring the operation of ice protection systems, the effect of their use on the net flight path must be taken into account. Although the FAR does not explicitly state this requirement in parts 121 or 135, it is effectively required by the FAA through policies associated with FAA-approved Airplane Flight Manuals (AFM's). FAA policies require the en route net flight path data provided in the AFM to include the effects of the operation of anti-ice systems. Since these data are operating limitations, operators are required to abide by them.

The JAR requires a path width of 5 nautical miles on each side of the intended track to be considered when determining compliance with the vertical obstacle clearance requirements. The FAR path width is 5 statute miles on either side of the intended track. Since the FAR path width is slightly narrower, terrain that must be considered under the JAR requirement may not have to be considered under the FAR. Therefore, the JAR is more stringent.

The FAR requires that the obstacle clearance analysis assume that the airplane passes over the critical obstruction after an engine failure at a point that is no closer to the obstruction than the nearest approved radio navigation fix, unless the Administrator authorizes a different procedure based on adequate operational safeguards. The JAR requires the path width over which obstacle clearance must be shown to be increased from 5 to 10 nautical miles if the navigational accuracy does not meet the 95% containment level. The FAR requirement limits the procedural means that may be used to comply with the en route obstacle clearance requirements, while the JAR requirement increases the area under the flight path for which the required terrain clearance must be shown if the navigational accuracy does not support the narrower path width.

The JAR requires account to be taken of the effects of winds on the flight path, while the FAR only requires the effect of adverse winds to be taken into account. The only difference is that the JAR requires favorable, in addition to adverse winds to be taken into account. Since the effect of favorable winds would never be more limiting than a zero wind case, the extra JAR requirement is neither more stringent nor less stringent than the FAR.

The JAR requires that the airport where the aeroplane is assumed to land after engine failure must meet the following criteria: (1) the performance requirements at the expected landing mass are met and (2) weather reports or forecasts, or any combination thereof, and field condition reports indicate that a safe landing can be accomplished at the estimated time of landing. The FAR requires that the alternate airport where the airplane is assumed to land is specified in the dispatch or flight release and meets the prescribed weather minimums. The FAR landing limitations of § 121.195 require that the performance requirements at the expected landing weight are met at the alternate airport. The FAR and JAR standards are similar although the applicable issues are handled differently within the standards.

The FAR requires that the consumption of fuel and oil after engine failure used to show compliance with the en route limitations is the same as the consumption that is allowed for in the approved net flight path data in the Airplane Flight Manual. The JAR does not contain such a requirement. Because the FAR contains a requirement not in the JAR, it could be said that the FAR is more stringent. However, because the same AFM data are used to show compliance with the FAR and JAR requirements, there are no practical differences resulting from the differences in the standards.

Both the FAR and the JAR require safe obstacle clearance after failure of two engines unless the airplane is always within 90 minutes of an acceptable alternate airport. The JAR restricts the applicability of this requirement to airplanes with three or more engines, but the FAR does not. Therefore, this FAR standard effectively prohibits two-engine airplanes from operating on routes that do not at all times remain within 90 minutes from an acceptable alternate airport. This consequence was noted in the preamble material associated with Amendment 1 to SR-422B, (27 FR 12399):

"Pursuant to the en route limitations. . ., airplanes are precluded from flying along an intended route if any place along the route is more than 90 minutes from a suitable airport unless compliance is shown with the two-engine-inoperative en route limitations. . . These requirements automatically prohibit two-engine airplanes from flying such routes."

The advent of Extended Range Operations with Two-Engine Airplanes (ETOPS) has superceded this requirement for airplanes authorized to operate on such routes, although the working group was unable to locate any documentation stating this. It is considered reasonable to assume that the FAA did not intend for ETOPS authorizations involving routes more than 90 minutes away from an acceptable alternate airport to be prohibited by § 121.193.

The JAR specifies the 90 minute distance as that resulting from 90 minutes at the all engines long range cruising speed. For the FAR, the 90 minute distance is that resulting from 90 minutes with all engines operating at cruising power. The JAR is more stringent in that it specifies the speed that must be used to show compliance with this requirement. The FAR is more flexible in only specifying the engine power level that must be assumed, but allowing an operator to propose the use of any appropriate speed that can be achieved with cruising power on the engines.

When safe obstacle clearance must be shown with two engines inoperative, the JAR specifies that the two engines are assumed to fail at the most critical point of that portion of the route where the airplane is more than 90 minutes away from an airport that meets the landing distance performance requirements. The FAR requires the two engine failures to be assumed to occur at the most critical point en route, regardless of the distance from an airport.

The JAR requires that the expected mass of the airplane at the point where the two engines are assumed to fail must not be less than that which would include sufficient fuel

to proceed to an airport where the landing is assumed to be made, and to arrive there at least 1500 ft directly over the landing area and thereafter to fly level for 15 minutes. The FAR requirement is the same, except that the 15 minutes of flight after arriving at the destination are at cruise power or thrust, rather than in level flight.

4 - What, if any, are the differences in the current means of compliance? [Provide a brief explanation of any differences in the current compliance criteria or methodology (e.g., issue papers), including any differences in either criteria, methodology, or application that result in a difference in stringency between the standards.]

There are no differences in the means of compliance other than those resulting from the differences in the standards.

5 – What is the proposed action? [Describe the new proposed requirement, or the proposed change to the existing requirement, as applicable. Is the proposed action to introduce a new standard, or to take some other action? Explain what action is being proposed (not the regulatory text, but the underlying rationale) and why that direction was chosen for each proposed action.]

The proposed action is to harmonize the standards by selecting portions of each standard to become the harmonized standard.

For each proposed change from the existing standard, answer the following questions:

6 - What should the harmonized standard be? [Insert the proposed text of the harmonized standard here]

FAR 121.191 Airplanes: Turbine-engine-powered: En route limitations: One engine inoperative

(a) No person operating a turbine engine powered airplane may take off that airplane at a weight, allowing for normal consumption of fuel and oil, that is greater than that which (under the approved, one engine inoperative en route net flight path data in the Airplane Flight Manual for that airplane) will allow compliance with paragraphs (a)(1) or (2) of this section, based on the ambient temperatures and meteorological conditions expected en route.

(1) There is a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five nautical miles on each side of the intended track, and, in addition, if that airplane was certificated after August 29, 1959 (SR422B) there is a positive slope at 1,500 feet above the airport where the airplane is assumed to land after an engine fails.

(2) The net flight path allows the airplane to continue flight from the cruising altitude to an airport where a landing can be made under section 121.197, clearing all terrain and obstructions within five nautical miles on each side of the intended track by at least 2,000 feet vertically and with a positive slope at 1,000 feet above the airport where the airplane

lands after an engine fails, or, if that airplane was certificated after September 30, 1958 (SR422A, 422B), with a positive slope at 1,500 feet above the airport where the airplane lands after an engine fails.

(b) For the purposes of paragraph (a)(2) of this section, it is assumed that -

(1) The engine fails at the most critical point en route;

(2) An approved method is used to account for the effect of winds;

(3) Fuel jettisoning will be allowed if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(4) The alternate airport where the airplane is assumed to land is specified in the dispatch or flight release and meets the prescribed weather minimums.

§ 121.193 Airplanes: Turbine engine powered: En route limitations: Two engines inoperative.

* * *

(c) Aircraft certificated after August 29, 1959 (SR422B). No person may operate a turbine engine powered airplane along an intended route unless that person complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets § 121.197.

(2) Its weight, according to the two-engine-inoperative, en route net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets § 121.197, with the net flight path (considering the ambient temperatures and meteorological conditions anticipated along the track) clearing vertically by at least 2,000 feet all terrain and obstructions within five nautical miles on each side of the intended track. For the purposes of this paragraph, it is assumed that—

(i) The two engines fail at the most critical point of that portion of the route where the airplane is more than 90 minutes (with all engines operating at cruising power) from an airport that meets the requirements of § 121.197;

(ii) The net flight path has a positive slope at 1,500 feet above the airport where the landing is assumed to be made after the engines fail;

(iii) Fuel jettisoning will be approved if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(iv) The airplane's weight at the point where the two engines are assumed to fail provides enough fuel to continue to the airport, to arrive at an altitude of at least 1,500 feet directly over the airport, and after that to fly for 15 minutes at cruise power or thrust, or both; and

FAR 135.381 Large transport category airplanes: Turbine engine powered: En route limitations: One engine inoperative.

(a) No person operating a turbine engine powered large transport category airplane may take off that airplane at a weight, allowing for normal consumption of fuel and oil, that is greater than that which (under the approved, one engine inoperative, en route net flight path data in the Airplane Flight Manual for that airplane) will allow compliance with paragraph (a) (1) or (2) of this section, based on the ambient temperatures and meteorological conditions expected en route.

(1) There is a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions within five nautical miles on each side of the intended track, and, in addition, if that airplane was certificated after August 29, 1958 (SR422B), there is a positive slope at 1,500 feet above the airport where the airplane is assumed to land after an engine fails.

(2) The net flight path allows the airplane to continue flight from the cruising altitude to an airport where a landing can be made under § 135.387 clearing all terrain and obstructions within five nautical miles of the intended track by at least 2,000 feet vertically and with a positive slope at 1,000 feet above the airport where the airplane lands after an engine fails, or, if that airplane was certificated after September 30, 1958 (SR422A, 422B), with a positive slope at 1,500 feet above the airport where the airplane lands after an engine fails.

(b) For the purpose of paragraph (a)(2) of this section, it is assumed that—

(1) The engine fails at the most critical point en route;

(2) An approved method is used to account for the effect of winds;

(3) Fuel jettisoning will be allowed if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(5) The alternate airport is selected and meets the prescribed weather minimums.

§ 135.383 Large transport category airplanes: Turbine engine powered: En route limitations: Two engines inoperative.

* * *

(c) Aircraft certificated after August 29, 1959 (SR422B). No person may operate a turbine engine powered large transport category airplane along an intended route unless that person complies with either of the following:

(1) There is no place along the intended track that is more than 90 minutes (with all engines operating at cruising power) from an airport that meets § 135.387.

(2) Its weight, according to the two-engine-inoperative, en route net flight path data in the Airplane Flight Manual, allows the airplane to fly from the point where the two engines are assumed to fail simultaneously to an airport that meets § 135.387, with the net flight path (considering the ambient temperatures and meteorological conditions anticipated along the track) clearing vertically by at least 2,000 feet all terrain and obstructions within five nautical miles on each side of the intended track. For the purposes of this paragraph, it is assumed that—

(i) The two engines fail at the most critical point of that portion of the route where the airplane is more than 90 minutes (with all engines operating at cruising power) from an airport that meets the requirements of § 135.387;

(ii) The net flight path has a positive slope at 1,500 feet above the airport where the landing is assumed to be made after the engines fail;

(iii) Fuel jettisoning will be approved if the certificate holder shows that the crew is properly instructed, that the training program is adequate, and that all other precautions are taken to ensure a safe procedure;

(iv) The airplane's weight at the point where the two engines are assumed to fail provides enough fuel to continue to the airport, to arrive at an altitude of at least 1,500 feet directly over the airport, and after that to fly for 15 minutes at cruise power or thrust, or both; and

JAR-OPS 1.500 En-route – One Engine Inoperative (See AMC OPS 1.500)

(a) An operator shall ensure that the one engine inoperative en-route net flight path data shown in the Aeroplane Flight Manual, appropriate to the meteorological conditions expected for the flight, complies with either subparagraph (b) or (c) at all points along the route. The net flight path must have a positive gradient at 1500 ft above the aerodrome where the landing is assumed to be made after engine failure. In meteorological conditions requiring the operation of ice protection systems, the effect of their use on the net flight path must be taken into account.

(b) The gradient of the net flight path must be positive at least 1000 ft above all terrain and obstructions along the route within 9.3 km (5 nm) on either side of the intended track.

(c) The net flight path must permit the aeroplane to continue flight from the cruising altitude to an aerodrome where a landing can be made in accordance with JAR-OPS 1.510 and 1.515 or 1.520 as appropriate, the net flight path clearing vertically, by at least 2000 ft, all terrain and obstructions along the route within 9.3 km (5 nm) on either side of the intended track in accordance with subparagraphs (1) to (4) below:

(1) The engine is assumed to fail at the most critical point along the route;

(2) Account is taken of the effects of winds on the flight path;

(3) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome where the aeroplane is assumed to land after engine failure with the required reserves of JAR-OPS 1.255 appropriate to an alternate aerodrome, if a safe procedure is used, and

(4) The aerodrome where the aeroplane is assumed to land after engine failure must meet the appropriate landing minima of JAR-OPS 1.297:

(d) When showing compliance with JAR-OPS 1.500, an operator must increase the width margins of subparagraphs (b) and (c) above to 18.5 km (10 nm) if the navigational accuracy does not meet the 95% containment level.

JAR-OPS 1.505 En-route – Aeroplanes with Three or More Engines, Two Engines Inoperative

(a) An operator shall ensure that at no point along the intended track will an aeroplane having three or more engines be more than 90 minutes with all engines operating at cruising power, at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met unless it complies with subparagraphs (b) to (f) below.

(b) The two engines inoperative en-route net flight path data must permit the aeroplane to continue the flight, in the expected meteorological conditions, from the point where two engines are assumed to fail simultaneously, to an aerodrome at which it is possible to land and come to a complete stop when using the prescribed procedure for a landing with two engines inoperative. The net flight path must clear vertically, by at least 2000 ft all terrain and obstructions along the route within 9. 3 km (5 nm) on either side of the intended track. At altitudes and in meteorological conditions requiring ice protection systems to be operable, the effect of their use on the net flight path data must be taken into account. If the navigational accuracy does not meet the 95% containment level, an operator must increase the width margin given above to 18.5 km (10 nm).

(c) The two engines are assumed to fail at the most critical point of that portion of the route where the aeroplane is more than 90 minutes, with all engines operating at cruising power at standard temperature in still air, away from an aerodrome at which the performance requirements of JAR-OPS 1.515 or 1.520 at the expected landing mass are met, and where the landing distance available is not less than the unfactored two-engine-inoperative landing distance.

(d) The net flight path must have a positive gradient at 1500 ft above the aerodrome where the landing is assumed to be made after the failure of two engines.

(e) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome with the required fuel reserves of sub-paragraph (f) below, if a safe procedure is used.

(f) The expected mass of the aeroplane at the point where the two engines are assumed to fail must not be less than that which would include sufficient fuel to proceed to an aerodrome where the landing is assumed to be made, and to arrive there at least 1500 ft directly over the landing area and thereafter to fly for 15 minutes at cruise power or thrust.

Summary of Proposed Changes:

As a minor editorial change to § 121.193(c), the word "he" would be replaced by "that person." This proposed change, which is consistent with the wording of the existing § 135.383(c), would remove the presumption that the operator is of the male gender.

In §§ 121.191(a), 121.193(c)(2), 135.381(a), and 135.383(c)(2), the words, "and meteorological conditions" would be added to the requirement to base compliance with these requirements on the ambient temperatures en route. The intent of adding these words is to ensure that the effects of ice protection systems (including, if provided in the Airplane Flight Manual, residual ice that may remain after the operation of the ice protection system), as reflected in the Airplane Flight Manual en route climb performance data, are taken into account when showing compliance to this requirement. This change is in accordance with current industry practice and FAA policy, and would harmonize the FAR with JAR-OPS 1.

The path width for showing adequate obstacle clearance in §§ 121.191(a)(1), 121.191(a)(2), 121.193(c)(2), 135.381(a)(1), 135,381(a)(2), and 135.381(c)(2) would be changed from five statue miles to five nautical miles. This change, which would increase the stringency of the existing FAR, is consistent with current industry practice and would harmonize this requirement with that of JAR-OPS 1.

The requirement in §§ 121.191(b)(2) and 135.381(b)(2) for the engine failure point to be assumed to be no closer to the obstruction than the nearest radio navigation fix would be removed. With the advanced navigation capabilities and cockpit displays of position

available on modern airplanes, this requirement is no longer considered necessary. The requirement to assume that the engine fails at the most critical point en route is considered to be sufficiently stringent to meet the safety intent.

The existing §§ 121.191(b)(3) and 135.381(b)(3) would be revised from requiring operators to allow for adverse winds to require operators to account for the effect of winds. Although, as noted earlier, this change would have no safety impact, it would harmonize the FAR with the JAR and clarify that operators may take into account the effect of any favorable winds.

The existing §§ 121.191(b)(6), 121.193(c)(2)(v), 135.381(b)(6), and 135.383(c)(2)(v) which require the consumption of fuel and oil assumed after engine failure to be the same as the consumption that is allowed for in the approved net flight path data in the Airplane Flight Manual (AFM), would be removed. Typically, the AFM provides climb gradient data as a function of airplane weight, and does not include fuel and oil consumption information. If net en route flight path data that includes fuel and oil consumption are provided in the AFM, operators would be required to use these data, including any fuel and oil consumption inherent in the data, regardless of whether or not an operating rule specifically calls this out. This proposal would harmonize the FAR with the JAR.

The section title for § 121.193 would be changed to add the words “for airplanes with three or more engines.” This proposed change would clarify that § 121.193 apply only to airplanes with three or more engines. Since § 121.161(a) restricts two-engine airplanes to routes remaining within 60 minutes of an adequate airport at the one-engine-inoperative cruising speed, application of the § 121.193 requirement to two-engine airplanes would never be limiting. Also, removing applicability of this requirement from two-engine airplanes would clarify that ETOPS authorizations are not meant to be limited by this requirement. Because part 135 does not have a requirement equivalent to § 121.161, nor are the ETOPS considerations applicable, there is not a corresponding proposal to change § 135.383.

Sections 121.193(c)(2)(i) and 135.383(c)(2)(i) would be revised to require consideration of a dual engine failure only during that portion of the route where the airplane is more than 90 minutes away from an airport that meets the requirements of §§ 121.197 and 135.387, respectively. This change would harmonize this requirement with the JAR standard and would be consistent with the existing FAR requirements in §§ 121.193(c) and 135.383(c) that a dual engine failure need only be considered if there is a point in the flight where the airplane is more than 90 minutes away from an airport that meets the requirements of §§ 121.197 and 135.387, respectively.

JAR-OPS 1.500(c)(4) would be revised to replace sub-paragraphs (i) and (ii) with a requirement to meet the appropriate landing minima of JAR-OPS 1.297. This change would continue to address the safety intent and would effectively harmonize the JAR with the FAR.

The reference to “at the all-engines long range cruising speed” in JAR-OPS 1.505(a) and (c) would be changed to “with all engines operating at cruising power” to harmonize with the FAR. This change would allow additional flexibility to operators who can substantiate the use of a speed other than the long range cruising speed to show compliance with this requirement. The long range cruise speed has a generally accepted definition within aviation of being a speed that provides 99 percent of the maximum range capability.

JAR-OPS 1.505(c) would additionally be changed to replace “the performance requirements applicable” to “the performance requirements of 1.515 or 1.520” to clarify what the applicable performance requirements are for the airport where the ensuing landing would be made. An additional performance requirement would be added to JAR-OPS 1.505(c) to further require that the landing distance available not be less than the unfactored two-engine-inoperative landing distance. This requirement was considered for addition into the FAR, but an examination of existing airplanes showed that it would never be limiting. The normal all-engines-operating landing limitations, including the landing distance safety margin applied under §§ 121.195, 121.197, 135.385, and 135.387 ensure that the landing distance will not be less than the unfactored two-engine-inoperative landing distance.

JAR-OPS 1.505(e) would be revised to reference sub-paragraph (f) as providing the fuel reserve requirements that must be present at the alternate airport. JAR-OPS 1.505(f) would be revised to replace the fuel allowance associated with flying level for 15 minutes with that required to fly for 15 minutes at cruise power or thrust.” Specifying the thrust or power level is more appropriate to establishing a fuel consumption requirement and would harmonize the JAR with the FAR.

7 - How does this proposed standard address the underlying safety issue (identified under #1)? [Explain how the proposed standard ensures that the underlying safety issue is taken care of.]

The proposed standard continues to address the underlying safety issues in the same manner as the existing standard.

8 - Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Explain how each element of the proposed change to the standards affects the level of safety relative to the current FAR. It is possible that some portions of the proposal may reduce the level of safety even though the proposal as a whole may increase the level of safety.]

The proposed standard would maintain approximately the same level of safety relative to the current FAR. The increase in path width for determining compliance with the obstacle clearance requirements could result in an increase in the level of safety relative to the existing FAR requirements.

9 - Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Since industry practice may be

different than what is required by the FAR (e.g., general industry practice may be more restrictive), explain how each element of the proposed change to the standards affects the level of safety relative to current industry practice. Explain whether current industry practice is in compliance with the proposed standard.]

The proposed standard would maintain the same level of safety relative to the current FAR. The current industry practice is to use the 5 nautical mile path width.

10 - What other options have been considered and why were they not selected? [Explain what other options were considered, and why they were not selected (e.g., cost/benefit, unacceptable decrease in the level of safety, lack of consensus, etc.) Include the pros and cons associated with each alternative.]

The option that was selected appeared to provide the maximum benefit from harmonization with minimal cost impact. For the one item that remains unharmonized, the JAR requirement relating obstacle clearance path width to navigational capability, there does not appear to be a compelling reason to harmonize. The airplanes expected to be operating on competing routes between European and U.S. operators would meet the 95 percent containment level requirement of the JAR, and hence would be subject to the 5 nautical mile path width requirement that is harmonized between the FAR and the JAR.

In addition, the working group considered updating the two-engine-inoperative en route limitations to better reflect the safety, reliability, and capability of modern airplanes and engines. Under the proposed harmonized standards, three and four engined airplanes may be prohibited from operating on certain routes available to twinjets. For example, an operator found that operating the 727 from the U.S. West Coast to Hawaii would not be economically viable due to the § 121.193 fuel loading requirements associated with two-engine-inoperative flight. However, the same operation under ETOPS criteria with a twinjet is economically viable. On other routes, the terrain clearance requirements of § 121.193 prohibit three and four engine airplanes from operating on routes open to twins operating under ETOPS authority. Considering that § 121.193 is concerned with the consequences of multiple engine failures, where the three and four engine airplanes inherently have an advantage, such outcomes do not appear to be completely rational. Also, the enhanced navigational capabilities of modern jet transports are not fully taken into account.

Because such an update to § 121.193 is beyond the scope of simply harmonizing the FAR and JAR standards, the working group did not pursue this option. However, the working group recommends tasking ARAC to update § 121.193 so that it is more applicable to the modern jet transport fleet – regardless of the number of engines on the airplane.

11 - Who would be affected by the proposed change? [Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.]

Operators of transport category airplanes could be affected by the proposed change.

12 - To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble? [Does any existing

advisory material include substantive requirements that should be contained in the regulation? This may occur because the regulation itself is vague, or if the advisory material is interpreted as providing the only acceptable means of compliance.]

None.

13 - Is existing FAA advisory material adequate? If not, what advisory material should be adopted? [Indicate whether the existing advisory material (if any) is adequate. If the current advisory material is not adequate, indicate whether the existing material should be revised, or new material provided. Also, either insert the text of the proposed advisory material here, or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy, Order, etc.)]

No additional advisory material is necessary.

14 - How does the proposed standard compare to the current ICAO standard? [Indicate whether the proposed standard complies with or does not comply with the applicable ICAO standards (if any)]

The applicable ICAO standard is contained in Annex 6, "Operation of Aircraft," Chapter 5, "Aeroplane Performance Operating Limitations," Paragraph 5.2.10, reproduced as follows:

En Route – two power-units inoperative. In the case of aeroplanes having three or more power-units, on any part of a route where the location of en-route alternate aerodromes and the total duration of the flight are such that the probability of a second power-unit becoming inoperative must be allowed for if the general level of safety implied by the Standards of this chapter is to be maintained, the aeroplane shall be able, in the event of any two power-units becoming inoperative, to continue the flight to an en-route alternate aerodrome and land.

The proposed standard would remain in compliance with the ICAO standard.

15 - Does the proposed standard affect other HWGs? [Indicate whether the proposed standard should be reviewed by other harmonization working groups and why]

No.

16 - What is the cost impact of complying with the proposed standard? [Please provide information that will assist in estimating the change in cost (either positive or negative) of the proposed rule. For example, if new tests or designs are required, what is known with respect to the testing or engineering costs? If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs? In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.]

Any cost impact is expected to be negligible.

17 - If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

N/A

18 - Does the HWG wish to answer any supplementary questions specific to this project? [If the HWG can think of customized questions or concerns relevant to this project, please present the questions and the HWG answers and comments here.

No.

19 – Does the HWG want to review the draft NPRM prior to publication in the Federal Register?

Yes.